FACULTY OF PHARMACY

STUDY PROGRAM 0916.1 PHARMACY

DEPARTMENT OF PHARMACEUTICAL AND TOXICOLOGICAL CHEMISTRY

APPROVED
at the meeting of the Commission for Quality Assurance and Evaluation of the Curriculum, Faculty of Pharmacy
Minutes No. 2 of 21.12.2017
Chairman PhD. associate professor
UNCU Livia

APPROVED
at the Council meeting of the Faculty of Pharmacy
Minutes No. 2 of 22.12.2017
Dean of Faculty PhD. associate professor
CIOBANU Nicolae

APPROVED
at the meeting of the chair of Pharmaceutical and Toxicological Chemistry.
Minutes No. 3 of 03.11.2017
Head of chair PhD. professor
VALICA Vladimir

SYLLABUS

DISCIPLINE **TOXICOLOGICAL CHEMISTRY**

Integrated studies

Typeof course: **Compulsory**

Chisinau, 2017

I. PRELIMINARIES

- **General presentation of the discipline: its place and role in specific competences formation of professional/specialty training program**

Toxicological Chemistry is one of pharmaceutical disciplines, which deals with the study of the properties of the toxic compounds, their behavior in the living body and the corpse, the processing of the methods of isolation, extraction and determination of toxic compounds and metabolites in biological objects.

The components of toxicological chemistry are: **biochemical toxicology** which includes problems of toxins' action in organisms in the primary metabolism (in living organisms) of the toxicant depending on the absorption, distribution, biotransformation and excretion, as well as the secondary (cadaveric) metabolism of the toxicants under the action of the ferments; and **analytical toxicology** which includes problems of elimination of toxins and metabolites from the selected biological material (cadaveric), bio-substrata of living persons, confirmation of intoxications with certain compounds, identification, quantitative determination of these compounds and interpretation of the results of the chemical-toxicological analysis.

Knowledge of the theoretical and practical bases of toxicological chemistry is necessary for the pharmacist to further specialize in chemical-judicial expertise, clinical toxicology, addiction medicine, forensics, clinical pharmacy and ecology.

- **Curriculum mission (its goal) in professional training**

The goal of discipline Toxicological Chemistry is formation of principles of methodological and systemic approach to the information on chemical-toxicological analysis i.e. systemic analytical research, the aim of which is to isolate the toxicant and metabolites from the biological material of different kind, isolation and quantitative determination of these compounds in the extracts obtained followed by the interpretation of the results review.

- **Language/languages of the course:** Romanian, English.

- **Beneficiaries:** students of the IV year, faculty Pharmacy, specialty PHARMACY.

II. MANAGEMENT OF DISCIPLINE

Code of discipline		**S.07.O.073**	
Discipline's name		**Toxicological chemistry**	
Person in charge of discipline		PhD in Pharmaceutical Sciences, associate professor **Cotelea Tamara**	
Year	**IV**	Semester	**VII**
Total number of hours, including:			**180**
Lectures	**34**	Practical/laboratory hours	**51**
Seminars	**-**	Self-training	**95**
Form of assessment	**E**	Number of credits	**6**

III. TRAINING AIMS WITHIN DISCIPLINE

At the end of the discipline, the student will be able to:

- ***at the level of knowledge and understanding:***
  - to know the bases of legislation on judicial and narcotic expertise in Moldova;
  - to understand the principles of assuring the quality of judicial expertise;
  - to know the principles of biochemical toxicology (toxic kinetics, toxic dynamics);
  - to know the classification of narcotic psychotropic compounds and other toxic compounds and their physicochemical characteristic;
  - to know the methodology of interpretation of the chemical-toxicological analysis with the particularities of the judicial expertise of the analytical diagnostics of acute drug intoxications and intoxications;
  - to understand the methods of isolation of toxic compounds from biological objects and other province for performing chemical-toxicological analysis;
  - to understand methods for analyzing toxins of organic and inorganic origin.
- ***at the application level:***
  - to select biological objects for preliminary preparation and research;
  - to isolate different compounds from organic and non-organic objects;
  - to interpret screening-analysis;
  - to apply chemical, biological, instrumental analysis methods for the determination of toxic, narcotic and metabolite compounds;
  - to apply express methods of tests for the analytical diagnosis of narcomania, toxicomania, acute intoxications;

- to document the chemical-toxicological research.

- ***at the integration level:***

- to be able to implement the knowledge in solving the problems of the chemical-toxicological analysis in the argumentation of the diagnostic-analytical problem and the judicial expertise;
- to be able to know the contemporary methods of analysis and the possibilities of their application in conducting chemical-toxicological research;
- to be competent in provision of general distribution and biotransformation regularities of toxic compounds in the human body, the occurrence of the toxic effect, the toxic situation;
- be able to confirm the causes of poisoning at the level of molecular processes and their consequences on the tissue, the body as a whole;
- to be able to implement the knowledge gained in the research activity;
- to use with confidence the scientific information obtained using the new information and communication technologies;
- be able to use multimedia technology to receive, evaluate, store, produce, present and exchange information, and communicate and participate in networks through the Internet;
- to be able to learn, which will contribute to the management of the professional route;
- to be able to assess the place and role of toxicological chemistry in the preparation of the expert-pharmacist;
- to be competent to use the knowledge and methodology of toxicological chemistry in the ability to explain the nature of physiological or pathological processes.

IV. PROVISIONAL TERMS AND CONDITIONS

To acquire the toxicological chemistry course the student requires the following:

- knowledge of the instruction language;
- confirmed competences in sciences at the university level (biology, biochemistry, pharmaceutical chemistry, biophysics, physiopathology, anatomy, bio-organic chemistry);
- digital skills (use of the Internet, document processing, spreadsheet electronic tables and presentations, use of graphics software);
- ability to communicate and teamwork skills;
- qualities – tolerance, compassion, autonomy.

V. TOPICSANDHOURS ALLOCATION ESTIMATE

Lectures, practical hours/ laboratory hours /seminars and self-training

No.	THEME	Number of hours		
		Lectures	Practical hours	Self-training
1.	Toxicological Chemistry in Higher Pharmaceutical Education. Fundamental concepts. Biochemical and analytical toxicology, parts of toxicological chemistry. The toxickinetic and toxicdynamic mechanism in the body.	2	-	-
2.	Etiology of intoxications, methodology, particularities of chemical-toxicological analysis of drug compounds.	2	3	-
3.	The peculiarities of research of acidic, neutral and weakly basic drug compounds while separated by polar solvents: barbiturate derivatives, salicylic acid, pyrazolone, purine, THC acid.	2	3	10
4.	The etiology of benzodiazepine intoxications. Toxicological analysis.	2	3	6
5.	Particularities of analysis of basic compounds. Importance of chemical-toxicological analysis of alkaloids.	2	3	10
6.	Particularities of the chemical-toxicological analysis of isoquinoline and tropane derivatives.	4	3	10
7.	Particularities of chemical-toxicological analysis of basic compounds, derived from: pyridine, quinine, phenylalkylamine, phenothiazine, LSD_{25} .	2	3	8
8.	The characteristic of the toxicological mechanism of volatile compounds. Particularities of chemical-toxicological analysis. Metabolism of volatile compounds.	4	3	10
9.	Applying the CGL method in the chemical-toxicological analysis. Principles. Analysis parameters' particularities.	2	3	15
10.	Ethanol Determination Methodology in Biological Liquids. Toxic kinetics. Toxic dynamics. Metabolism.	2	3	6
11.	Heavy metal poisoning etiology, metabolism. Particularities of the chemical-toxicological analysis of mercury.	2	3	6
12-13.	Particularities of the fractional method of chemical-toxicological analysis of metals in the biological material.	4	3	9
14.	Pesticides. Toxicological characteristics and etiology of pesticides. Particularities of chemical-toxicological analysis.	2	3	3
15.	Chemical and toxicological analysis in case of poisoning with carbon oxide, mineral acids, bases, nitrates and nitrites.	2	-	2

No.	THEME	Number of hours		
		Lectures	Practical hours	Self-training
16-17.	Practical applications on the chemical-toxicological analysis of toxins in the body.	-	6	-
18.	*Control assessments - 1, 2, 3.*	-	9	-
Total		**34**	**51**	**95**

VI. REFERENCE OBJECTIVESOFCONTENT UNITS

Objectives	Content Units
Theme (chapter) 1. Methodology and peculiarities of chemical-toxicological analysis of toxic compounds (drug and narcotics), isolated from biological material.	
• To define the toxicological action of the drug compounds as a chemical pathology; • to know the homeostasis disrupting ways, compounds action on biochemical mechanisms; • to define the main causes of intoxication; • to integrate knowledge about poisoning types; • to integrate knowledge about the causes of intoxication; • to define the particularities of the chemical-toxicological analysis of acidic, neutral, basic toxicities.	Toxics classification. The general features of medicine and narcotic compounds. Process of metabolism, toxicdynamics, toxickinetics. Relationships of the biological membranes fundamental mechanisms, enzymes, receptors. Phase reactionsof type I and II. Compartmental and bi-compartmental toxickinetic models.
Theme (chapter) 2. Particularities of the analysis of compounds containing tertiary nitrogen.	
• To define the physical and chemical properties of alkaloids; • to know the principles of alkaloids extraction; • demonstrate the properties of the chloroform extracted alkaloid analyzes; • to apply gained knowledge after the case studies analysis; • to define the alkaloids poisoning causes; • to define the preventive and special stages of analysis.	The general characteristics of alkaloids. Classification of alkaloids. Symptoms of alkaloids poisoning. External aspects of poisoning with alkaloids. The structure of the alkaloids. Instrumental methods applied in the chemical-toxicological analysis of alkaloids. Systematization of alkaloid analysis steps in the biological material. Principles underlying the Kramarenko analysis method.
Theme (chapter) 3. Importance of the chemical-toxicological analysis of volatile compounds.	
• To know the characteristic of volatile compounds;	The general characteristic of volatile toxicities. Their toxicological importance.

Objectives	Content Units
• to define the causes of poisoning with volatile compounds; • to know the physical and chemical properties of volatile toxins; • to demonstrate the possibilities of chemical and toxicological analysis of volatile toxicities in distillate; • to apply the knowledge in the case study.	Symptoms of intoxication. Interpretation phases of the chemical-toxicological analysis of volatile toxins. Samples preparation methods and the peculiarities of the volatile toxins isolation from biomaterial. Toxic kinetics and toxic dynamics of volatile toxins.
Theme (chapter) 4. Toxicological characteristics and chemical-toxicological analysis of heavy metals.	
• To know the chemical and toxicological analysis of mercury; • to know the physical and chemical properties of heavy metals, the toxicological importance of pesticides, the classification; • to explain the fractional analysis of heavy metals in the biological material; • to know the chemical and toxicological analysis of mineral acids, bases, nitrates.	Chronic and acute poisoning. Particularities of the chemical-toxicological analysis of mercury in the biological material. Isolation methods of from biological material. The fractional analysis principle of heavy metals. The mineralized residue obtaining. Analysis of precipitate and mineralized filtrate. As^{3+}analysis specifics from mineralized residue. Zanger-Blackmethod. Pesticide analysismethods.

VII. PROFESSIONAL (SPECIFIC (SC)) AND TRANSVERSAL (TC) COMPETENCES AND STUDY OUTCOMES

✓ Professional (specific) (SC) competences

- PC1. Demonstrating ability to make informed decisions to improve patient care to avoid drug intoxication.
- PC2. Using capacities to address toxicological problems by working with physicians. Promoting the principles of tolerance and compassion towards the patient.
- PC3. Possessing knowledge in determining the stages of chemical-toxicological analysis in acute and chronic intoxications. Establishing the correlation between the components of pharmaceutical activity and the problems of medical expertise.
- PC4.Perceiving the application of methods for the isolation of toxic compounds from biological and other proveniences to carry out chemical-toxicological analysis;
- PC5. Knowledge of the application of instrumental chemical methods of analysis for identification and quantitative determination of environmental isolates. Use of knowledge to explain the nature of toxicological processes.
- PC6. Knowing the bases of the chemical legal and narcotic expertise in the Republic of Moldova. Knowledge of the principles of quality of judicial expertise.

✓ Transversal competences (TC)

- TC1. Promoting the logical reasoning of the practical application of the methods of expertise. Promoting the logical reasoning of assessment and self-assessment in making decisions to describe the expertise bulletin. Compliance with pharmaceutical ethics and deontology rules for the release of medical remedies for the population and medical institutions.
- TC2. Identification of the training needs according to the evolution of the pharmaceutical system. Determining priorities in continuing professional training of the expert-pharmacist. Appreciation of changes in the forensic system as a condition of its functionality.

✓ Study outcomes

Upon completion of the course, the student will be able to:

- to know the organizational features, the fundamental properties of toxicological chemistry;
- to understand the principles of subdivision, conducting chemical-judicial expertise;
- to understand the toxic-receptor relationship; to understand the basic processes that ensure the increase of the detoxification in the process of metabolism and elimination of the toxic compound from the living organism;
- to know the bases and the practical role of complete metabolism;
- to assess the place and role of toxicological chemistry in the preparation of the expert pharmacist;
- to interpret the principles of quality assurance of judicial expertise;
- to understand the principles of biochemical toxicology (toxic kinetics, toxic dynamics);
- to know the classification, the physical and chemical characteristic of the narcotic compounds;
- to explain the methodology of interpreting the chemical-toxicological analysis with the particularities of the judicial expertise, the analytical diagnostics of the narcotics and the acute intoxications of chemical etiology;
- to know the methods of isolation of toxic compounds from biological objects and other province to perform chemical-toxicological analysis;
- to define the methods for analyzing toxins of organic and non-organic origin.

VIII. STUDENT'S SELF-TRAINING

No.	Expected product	Implementation strategies	Assessment criteria	Implementation terms
1.	Working with information sources.	Read the lecture or the material in the manual to the respective theme carefully. Read questions on the subject, which requires a reflection on the subject. To get acquainted with the list of additional information sources on the topic. Select the source of additional information for that theme. Reading the text entirely, carefully and writing the essentials. Wording of generalizations and conclusions regarding the importance of the theme / subject.	Ability to extract the essentials; interpretative skills; the volume of work.	During the semester
2.	Working with the practical hours' notebook. Minutes.	Until solving the tasks in the notebook to analyze the information and images from the respective subject in the lecture and handbook. Solving consecutive tasks. Formulate conclusions at the end of lesson. Verify the lesson's outcome and their achievement assessment. Selection of additional information, using electronic addresses and additional bibliography.	Workload, problem solving, ability to formulate conclusions.	During the semester
3.	Applying different learning techniques.	Technique of bulletin of expertise performing. Formulation of research methods of toxic compounds in the biological material for the elaboration of the bulletin of expertise.	Volume of work, level of insight into different subjects, level of scientific argumentation, quality of conclusions, elements of creativity, demonstration of understanding the problem, formation of personal attitude.	During the semester

No.	Expected product	Implementation strategies	Assessment criteria	Implementation terms
4.	Working with online materials.	Self-assessment, study of online materials on the department's website, expressing your own opinions through forum and chat.	The number and duration of entries on the site, the results of self-assessments.	During the semester
5.	Preparing and defending the presentations/portfolios.	Selection of the research theme, establishment of the research plan, setting the terms of realization. Establishment of project / presentation components PowerPoint – theme, purpose, results, conclusions, practical applications, bibliography. Peer reviews. Teacher reviews.	The volume of work, the degree of penetration in the essence of the project theme, the level of scientific argumentation, the quality of the conclusions, the elements of creativity, the formation of the personal attitude, the consistency of the exposure and the scientific correctness, the graphic presentation, the presentation method	During the semester

IX. METHODOLOGICAL SUGGESTIONSFOR TEACHING-LEARNING ASSESSMENT

- ***Teaching and learning methods used***

  At teaching the discipline ***Toxicological chemistry*** are used various didactic methods and procedures, oriented towards the efficient acquisition and achievement of the objectives of the didactic process. In the theoretical lessons, along with traditional methods (lesson-exposure, lesson-conversation, lesson synthesis), modern methods (lesson-debate, lesson-conference) are also used. During practical hours are used forms of individual, frontal, and group work. For the deeper learning of the material, different semiotic systems (scientific language, graphical language) and teaching materials (tables, schemes, photographs) are used. Within the lessons and extracurricular activities are used Communication Information Technologies - PowerPoint presentations).

- ***Applied teaching strategies / technologies*** *(specific to the discipline)*

  Inductive, deductive strategies, teaching and learning strategies are developed

using models (analogue strategies), algorithmic strategies: explicative-demonstrative, intuitive, exponential, imitative and algorithmic; heuristic strategies - to develop knowledge through their own thinking effort, using problem-solving, discovery, modeling, hypothesis formulation, heuristic dialogue, investigative experiment, brainstorming, having the effect of stimulating creativity.

- ***Methods of assessment*** *(including the method of final mark calculation).*

Current: frontal or/and individual control via:

(a) application of docimological tests;
(b) solving problems/exercises;
(c) analysis of case studies;
(d) achievement of playing roles at the discussed topics;
(e) control assesments – 3;
(f) the current assessment of self-training at the end of the semester.

The average mark is calculated by average of the marks obtained at control assesments and the mark of self-training.

Final: ***Exam*** - practical test, test-editor and oral answer.

The final mark at the ***exam*** will consist of the annual average score (30%), the practical skills (20%), the test editor (20%) and the oral answer (30%).

Method of mark rounding at assessment stages

Intermediate mark scale (annual average, marks from examination stages)	National Assessment System	ECTS Equivalent
1,00-3,00	**2**	**F**
3,01-4,99	**4**	**FX**
5,00	**5**	**E**
5,01-5,50	**5,5**	
5,51-6,0	**6**	
6,01-6,50	**6,5**	**D**
6,51-7,00	**7**	
7,01-7,50	**7,5**	**C**
7,51-8,00	**8**	
8,01-8,50	**8,5**	**B**
8,51-8,00	**9**	
9,01-9,50	**9,5**	**A**
9,51-10,0	**10**	

The average annual mark and the marks of all stages of final examination (computer assisted, test, oral) - are expressed in numbers according to the mark scale (according to the table), and the final mark obtained is expressed in number with two decimals, which is transferred to student's record-book.

Absence on examination without good reason is recorded as "absent" and equivalent to 0 (zero). The student has the right to have two re-examinations.

RECOMMENDED LITERATURE:

A. Compulsory:

1. Course support.
2. Brodicico T.M.; Valica V. Curs de Chimie toxicologică.– Chişinău: Centrul Editorial-Poligrafic Medicina al USMF, 2003.
3. Loghin F.; Popa D. Analize şi evaluări toxicologice. – Cluj-Napoca. Editura Medicală Universitară „Iuliu Haţieganu", 2003.
4. Loghin F.; Toxicologie generală. – Cluj-Napoca. Editura Medicală Universitară „Iuliu Haţieganu", 2003.
5. Methodical indications.

B. Addutional:

1. Baconi D. Toxicomanii. Note de curs. – Editura Tehnoplast Company SRL, 2009.
2. Baconi D.; Bălălău D.; Abramov P. Abuzul şi toxicodependenţa. Mecanisme, manifestări, tratament, legislaţie. – Bucureşti: Editura Medicală, 2008.
3. Cotrau M.; Popa L.; Stan T.; Preda N.; Kincses M. Toxicologie. – Bucureşti: Editura Didactica şi Pedagogica, 1991.
4. Proca M.; Butnaru E. Toxicologie, vol. I, Iaşi. Editura Timpul, 2000.
5. Веселовская Н.В.; Коваленко К. Наркотики. – Москва: Триада-Х, 2000.
6. Еремин С.К.; Изотов Б.Н.; Веселовская Н.В. Анализ наркотических средств. Москва: Мысль, 1993.
7. Лужников Е.Д. Клиническая токсикология. – М.: Медицина, 1994.
8. Марковой И.В. и др. Клиническая токсикология детей и подростков., ч. I, ч. II.- Санкт-Петербург: Интермедика, 1998, 1999.
9. Симонова Л.Л. Курс лекций по токсикологической химии. – Кишинев, 2003. Butnaru E.; Proca M. Toxicologie, vol. II, Iaşi. Editura Timpul. 2001.